International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 8; Issue 01(A); January 2019; Page No. 16737-16740
DOI: http://dx.doi.org/10.24327/ijcar.2019.16740.3105

Review Article

RIDGE SPLIT AND RIDGE EXPANSION APPROACH FOR TREATMENT OF DEFICIENT ALVEOLAR RIDGES: A CONTEMPORARY REVIEW

Ajit Jankar., Suresh Kamble., Sandeep Fere., Shruti Botwe., Susheen Gajare and Shashi Patil

Department of Prosthodontics, Maharashtra Institute of Dental Science and Research, Latur, Maharashtra

A R T I C L E I N F O

Article History:

Received 15th October, 2018
Received in revised form 7th October, 2018
Accepted 13th December, 2018
Published online 28th January, 2019

Key words:

Narrow alveolar ridges, ridge augmentation, ridge splitting, ridge expansion.

A B S T R A C T

Tooth loss and subsequent ridge collapse leading to narrowing of dentoalveolar ridges continues to burden the restorative implant treatment. Several techniques for ridge augmentation have been suggested such as guided bone regeneration, bone block grafting, ridge splitting, distraction osteogenesis etc. The ridge splitting predictably being a viable procedure wherein an atrophic ridge can be expanded & grafted, eliminating the need of second surgical site with minimal trauma to the patient and rare risk of injury to the vital anatomical structures. This article presents a detailed description of implant driven ridge split technique for ridge expansion procedures.

*Copyright©2019 **Ajit Jankar et al.** This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

INTRODUCTION

Patients with atrophic ridges remain a major limitation for successful implant placement and subsequent prosthetic rehabilitation. Thus, ideal volume of hard and soft tissues is required to achieve the best treatment outcome. After the tooth loss, the resorptive process continues throughout the following years, majority of which occurs in first year; however, the rate of bone loss decreases progressively.[1-2] The labial cortex frequently undergoes rapid reconstruction after the tooth loss with approximately 25% decrease in volume within 1st year, followed by 40-60% decrease in width in following 3 years, as a result, labial cortex being more medial than its original position.[3] The resorption after tooth loss often jeopardizes the functional and esthetic outcome of treatment planned for prosthetic rehabilitation. Hence, the dental implant therapy has come up with various techniques for augmentation of deficient alveolar ridges to provide a functionally acceptable restoration which is in harmony with the adjacent natural dentition. These procedures include the bone grafting, guided bone regeneration, ridge split & expansion, distraction osteogenesis.[4] Ridge split and expansion of the existing residual ridge is one of the reliable methods to prepare the atrophic maxilla and mandible for implant insertion with wider diameter. This approach has also been referred as ridge splitting, bone spreading, ridge expansion, or osteotome technique.

Corresponding author:* **Ajit Jankar
Department of Prosthodontics, Maharashtra Institute of Dental Science and Research, Latur, Maharashtra

A method of ridge splitting was developed in the 1970s by Dr. Hilt Tatum[5] and used tapered channel formers and D-shaped osteotomes to expand the resorbed residual ridge. Many variations of the ridge split technique have been documented by various authors. Simion et al[6] in 1992 adopted a method of ridge splitting by a longitudinal greenstick fracture in order to extend the socket by osteotomies. Later, Scipioni et al[3], in 1994, revived a variation which described a partial thickness flap and vertical intraosseous incisions with the simultaneous displacement of the buccal cortical plate, including a part of cancellous bone, and implant placement.

The choice of treatment depends on several factors including clinician preferences and skills, anatomic region, amount of bone loss, maxillomandibular relationships, prosthetic requirements, esthetic demands, economic factors, and healing time necessities. This article reviews indications, limitations, surgical technique, advantages, disadvantages, complications and modifications associated with ridge splitting techniques.

Clinical Considerations of ridge split and ridge expansion technique

The Ridge split Procedure is based on few distinct surgical principles. Following characteristics should be considered during the procedure:

1. ***Bone density density:*** The bone density of maxillary alveolar ridge is usually less dense than the mandibular alveolar ridge and more amenable to a single-stage ridge split procedure, whereas the narrow mandibular

alveolar ridges are usually treated with 2 stage surgical approach.

2. ***Blood supply to the alveolar process and the role of periosteal vascularization:*** The complete reflection of a full-thickness buccal soft-tissue flap restricts the periosteal vascular supply to the buccal (labial) cortical plate and results in a devascularized graft during ridge split procedure. Careful tissue manipulation preserving the periosteum so as to maintain the peripheral vascularization has a vital importance.[7]
3. ***Wound healing by secondary intention:*** After the ridge split procedure, the alveolar ridges heal by secondary intention analogous to the grafted extraction socket. Resorbable or non-resorbable membranes may be employed to retain graft material, isolate the wound from the surrounding environment, and also guide the soft tissue's healing over the graft.

Indications

- Availability of adequate bone height without any vertical bone defect is required as the ridge splitting technique is suitable for augmenting the ridge width. A minimum ridge width of 3.0 is required consisting of cancellous (about 1mm) bone sandwiched between 2 cortical plates (about 1mm of each).
- The wider the layer of the cancellous bone between the cortical plates, where the split is made, the easier is the ridge split procedure to perform.
- Thinner cortical plates and softer cancellous bone make the maxillary ridge easier to expand; therefore, ridge splitting is efficiently performed in maxilla than in mandible.
- In some cases, the narrow posterior mandibular ridges can be splited and expanded with successful results. A long edentulous span with abundant bone height superior to the inferior alveolar canal (>12 mm), and the presence of cancellous bone between the outer cortical plates can be considered as favorable conditions for the ridge split procedure.[4]

Limitations

- Splitting the narrower ridges (< 3mm) is often technique sensitive and may lead to bone fractures and resorption. It's conjointly troublesome to expand the narrow ridges in single tooth sites; for these cases other ridge augmentation techniques should be preferred.
- Ridge splitting should be avoided when facial bone concavities are present.
- Vertical bone defect resulting in unfavorable crown-to-implant ratios cannot be corrected using ridge split procedures as it only improves the width of the bone.[4]
- An unfavorable ridge relationship or significant medial resorption of the jaws might not be corrected using ridge splitting procedures, where other ridge augmentation techniques can be preferred such as onlay bone grafting.[8, 9]

Surgical approach for ridge split procedure*:*

Before the procedure, a thorough oral examination is done to assess the skeletal and dental maxillomandibular relationship. Proper radiographs (IOPA, panaromic radiographs) and making of diagnostic models along with the surgical stent for implant placement are mandatory preparations before the surgery. Although panoramic or periapical radiographs are routinely used, cone-beam computerized tomography (CBCT) the efficient way to evaluate the three dimensional anatomy of the alveolar ridges, thickness of the cortical & cancellous bone and the bone density at site of implant placement. For the prosthetically driven treatment planning, patient should wear a radiographic template during the scan. An assessment of postoperative and preoperative scans is done to evaluate the treatment outcome.[10] As an aid in assessment, palpation of the bone and ridge mapping can also be used.

Preoperative administration of antibiotics 1 hour prior to the procedure followed by a 1-week postoperative course of antibiotics is required. In addition, a 0.12% chlorhexidine rinse for 3 days before and 1 week after the procedure is adviced. Patient's sedation is recommended as repeated malleting is required to separate and outspread the cortical plates.

Surgical procedure can be explained as follows

1. Following the local anesthesia, an incision is made along the crest of the ridge. Minimal mucoperiosteal flap reflection is performed to expose the ridge crest only. The periosteum along the lateral cortices should remain intact to ensure the vascularity to the underlying bone.
2. The ridge width is re-evaluated & the bone dimensions and anatomy of the bone are determined if they are suitable for ridge splitting.
3. A round-handled scalpel with a No. 15 or round-tip beaver blade is used to begin the osteotomy that should bisect the ridge crest and separate the two cortical plates. A mallet can be used to advance the scalpel blade into the bone. The handle of the scalpel should be kept parallel to the palatal or lingual cortex.
4. After the scalpel blade is tapped to the desired depth, it should be gently removed with a back and forth motion to prevent breakage of the instrument. The length of the osteotomy should extend well beyond the planned implant sites along the ridge, which will allow the hinging effect of the bony plates at the base of the osteotomy. (Fig 1)

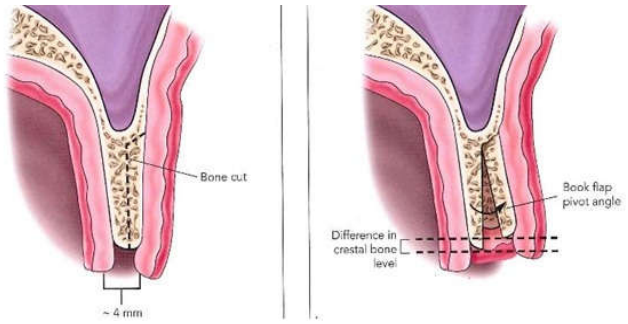

Fig 1 Split made within the cancellous bone bone showing showing hinging effect of the bony plates at the base of the osteotomy

5. After the crestal osteotomy, thin chisels, osteotomes, tapered fissure burs, or saws are used to further separate the cortices and start the ridge expansion.
6. A spatula osteotome can be useful to separate the outer cortical plates. A thin, tapered fissure bur or a saw blade is often preferred to complete the bony cut in case dense bone exists. (Fig 2,3)
7.

Fig 2 Bone splitting chisels

Fig 3 Osteotomes for Ridge expansion

8. Further, progressively wider chisels or osteotomes are gradually used gently for the expansion of ridge. As an alternative technique, osseodensification burs with progressively increasing diameters can be used for ridge expansion. (fig 4)

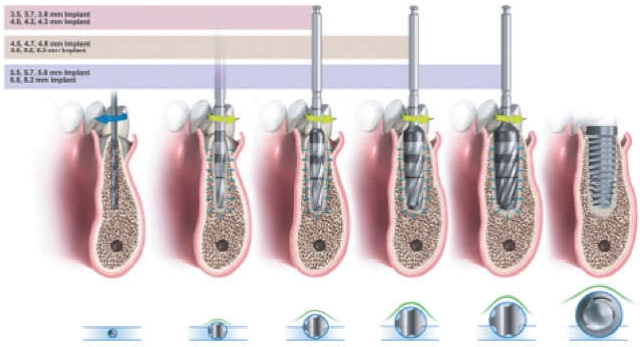

Fig 4 osseodensification burs for the expansion of ridge for the expansion of ridge

9. Implant site preparation can be done using the implant drills and careful insertion of the implant/ implants at the planned implant sites is performed to slowly expand the ridge and accommodate the desired implant diameter.
10. An orthodontic ligature wire or the absorbable ligatures can be used to stabilize the bone plates.[7,11]
11. Some clinicians may prefer to place bone graft materials around the implants and between the separated cortices. Platelet-rich plasma may be used to enhance wound healing.[12]
12. Regeneration of the bone between the separated plates requires adequate postoperative implant healing period (3 to 6 months).

Complications of the RSP

- Fracture of the buccal plate of the mandible during a single-stage split can occur where a full-thickness flap is fully reflected and the buccal cortex is devascularized, which has to be stabilized with mini screws and postponement of the procedure.
- Infection and uncontrolled bleeding can occur following the surgical procedure and are usually controlled with antibiotics/debridement and local hemostatic agents, respectively.
- Position of the mental foramen has to be determined preoperatively and monitored during the procedure to prevent neurosensory complications during mandibular ridge split procedure.[13]

Advantages

1. One of the advantages of ridge splitting over other ridge augmentation techniques is that implants can be placed simultaneously in single stage surgery.
2. Unlike guided bone regeneration, ridge splitting repositions the cortical plates around the implant, bone then regenerates within the space between the expanded cortical plates.
3. The treatment length is shorter compared with staged reconstructive approaches such as bone grafting or guided bone regeneration as the implants can be placed simultaneously with bone expansion.
4. The overall costs of implant treatment are also decreased. Barrier membranes or bone graft materials are not typically required with this technique.[14]

Disadvantages

- If complications arise and bone loss occurs, then the patient is usually left with an even greater bone defect than before the treatment. Therefore, proper case selection and surgical technique is very important when considering the ridge splitting techniques.[4]

Modifications of the Conventional ridge split and expansion procedures and instruments

- The horizontal alveolar ridge expansion with a titanium mesh plate using distraction osteogenesis principles or an alveolar crest widening/horizontal distraction device can also be used for a lateral augmentation of atrophic ridges.[15, 16]
- The Meisinger split control bone expansion kit uses a screw-type configuration of expansion and condensing burs and threadformers for lateral bone expansion with a delayed or simultaneous endosseous implant insertion.[17]
- Another approach for ridge split and expansion procedure is piezosurgery in the treatment of the atrophic jaw with narrow ridges. Piezosurgery with specially designed tips made split technique reduce the risk of complications in the treatment of extreme atrophic crests. Moreover, use of piezosurgery has made the alveolar ridge split technique be less dependent on the clinician's skills and less affected by the type of procedure chosen for the same.[18]
- Motor driven bone expanders also serves as an alternative for the conventional ridge expansion procedures using osteotomes. Motor driven bone expanders provide an enhanced control over the expansion site, therefore, allows treatment of more severely atrophic ridges, which would be of questionable prognosis with the use of traditional osteotomes.[19]
- Osseodensification is a novel bio-mechanical site preparation approach which utilizes a multi-fluted

Densifying Bur technology that creates and expands a pilot hole without excavating significant amounts of bone tissue through an efficient, highly controllable procedure with minimal heat elevation. This capability allows for clinical versatility enabling the implant surgeon to autograft the bone and efficiently expand any ridge in either jaw with enhanced implant stability.[20]

Summary

Ridge splitting technique being a predictable treatment modality for horizontal augmentation of the atrophic ridges has shown predictable treatment outcomes since past few decades. A collapsed alveolar ridge width (≥3mm) with grossly adequate bone height can be considered as an ideal indication to go for ridge split and expansion for prosthetic rehabilitation with implants. In addition, the surgical approach is more amenable to maxilla than in mandible as the bone in maxilla is comparatively less dense. Simultaneous insertion of implants with minimal or without any need for grafting makes the procedure more advantageous over other augmentation techniques. Proper case selection, technique of the surgery chosen and surgeon's skills are of utmost importance to achieve the successful surgical and prosthetic treatment outcome.

CONCLUSION

Judicious execution of ridge split and expansion technique has given predictable results in management of narrow ridges for implant placement or inter-positional bone grafting. Since the procedure allows minimal surgical interventions, reducing the patient's discomfort, cost and time required for the treatment, it has become the choice of treatment over other augmentation techniques. The implementation of newer methods for the ridge expansion has made the procedure a viable treatment option in treatment of atrophic ridges.

References

1. A. Tallgren, "The continuing reduction of the residual alveolar ridges in complete denture wearers: a mixed-longitudinal study covering 25 years," *Journal of Prosthetic Dentistry*, vol. 89, no. 5, pp. 427-435, 2003.
2. L. Sennerby, G. E. Carlsson, B. Bergman, and J. Warfvinge, "Mandibular bone resorption in patients treated with tissueintegrated prostheses and in complete-denture wearers," Acta Odontologica Scandinavica, vol. 46, no. 3, pp. 135-140, 1988.
3. Scipioni A, Bruschi GB, Calesini G. The edentulous ridge expansion technique: A five-year study. *Int J Periodontics Restorative Dent* 1994; 14:451-9.
4. Misch CM. Implant site development using ridge splitting techniques. Oral Maxillofac Surg Clin North Am. 2004; 16:65-74.
5. Tatum H Jr. Maxillary and sinus implant reconstructions. Dent Clin North Am 1986; 30:207-29.
6. M. Simion, M. Baldoni, and D. Zaffe, "Jawbone enlargement using immediate implant placement associated with a split-crest technique and guided tissue regeneration," *The International Journal of Periodontics & Restorative Dentistry*, vol. 12, no. 6, pp. 462-473, 1992.
7. Coatoam GW, Mariotti A. The segmental ridge-split procedure. *J Periodontol*. 2003;74:757-770.
8. Misch CM. Comparison of intraoral donor sites for onlay grafting prior to implant placement. *Int J Oral Maxillofacial Implants* 1997;12:767- 76.
9. Triplett RG, Schow SR. Autologous bone grafts and endosseous implants. Complementary techniques. J Oral Maxillofacial Surg 1996;54:486-94.
10. Rosenfeld AL, Mecall RA. The use of interactive computed tomography to predict the esthetic and functional demands of implant-supported prostheses. Compend Contin Educ Dent 1996; 17:1125- 44.
11. Santagata M, Guariniello L, D'Andrea A, Tartaro G. A modified crestal ridge expansion technique for immediate placement of implants: a report of three cases. J Oral Implantol. 2008;34(6):319-24.
12. Marx RE. Platelet-rich plasma: a source of multiple autologous growth factors for bone grafts. In: Lynch SE, Genco RJ, Marx RE, editors. Tissue engineering. applications in maxillofacial surgery and periodontics. Chicago: Quintessence Publishing; 1999. p. 71-82.
13. Tolstunov L, Hicke B. Horizontal augmentation through the ridge-split procedure: a predictable surgical modality in implant reconstruction. J Oral Implantol. 2013 Feb;39(1):59-68.
14. Scipioni A, Bruschi GB, Giargia M, et al. Healing at implants with and without primary bone contact. Clin Oral Impl Res 1997;8:39- 47.
15. Funaki K, Takahashi T, Yamuchi K. Horizontal alveolar ridge augmentation using distraction osteogenesis: comparison with a bone splitting method in a dog model. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;107:350-58.
16. Laster Z, Rachmiel A, Jensen OT. Alveolar width distraction osteogenesis for early implant placement. J Oral Maxillofac Surg. 2005;63:1724-1730.
17. Siddique A, Sosovicka M. Lateral bone condensing and expansion for placement of endosseous dental implants: a new technique. J Oral Implantol. 2006;32:87-94.
18. Alessandro Moro, Giulio Gasparini, Enrico Foresta, et al. Alveolar Ridge Split Technique Using Piezosurgery with Specially Designed Tips," BioMed Research International, vol. 2017, Article ID 4530378, 8 pages, 2017.
19. Rodriguez-Martinez JB, Munoz-Soto E, Peres MF, Chaves ES. Ridge expansion with motor driven bone expanders: A clinical case report. *Eur J Gen Dent* 2015;4:12-5.
20. Huwais S, Meyer EG. A Novel Osseous Densification Approach in Implant Osteotomy Preparation to Increase Biomechanical Primary Stability, Bone Mineral Density, and Bone-to-Implant Contact. *Int J Oral Maxillofac Implants*. 2017 Jan/Feb;32 (1):27-36.

****